U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

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METHODS FOR DETERMINING CUMULATIVE GOOSE KILL ON SPECIAL AREAS

BUREAU OF SPORT FISHERIES AND WILDLIFE
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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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METHODS FOR DETERMINING CUMULATIVE GOOSE KILL ON SPECIAL AREAS

By

William E. Green
Harvey K. Nelson
Charles W. Lemke

Special Scientific Report--Wildlife No. 72

Washington · May 1963

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METHODS FOR DETERMINING CUMULATIVE GOOSE KILL ON SPECIAL AREAS

By

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Wisconsin Conservation Department

The experimental work in Wisconsin described here may help others to measure more accurately than before goose kills in the vicinity of major concentration areas.

During the past 15 years considerable attention has been focused on management problems associated with the Mississippi Valley population of Canada geese. As indicated by Hanson and Smith (1951), the general breeding, migration, and wintering range is well identified. Because this flock of geese is closely associated with national wildlife refuges and State management areas in Wisconsin, Michigan, Ohio, Indiana, and Illinois, and the majority of this population winters in southern Illinois and immediate vicinity, it has been possible to determine quite accurately the annual size of this total population. (See figure 1)

Excessive kills in southern Illinois during the midforties resulted in special attention to regulations to control the harvest of geese from this population (Davis, 1954). Subsequent work by Hanson provided more detailed information on the sex and age composition of the population remaining at the close of the annual hunting season, productive potential, and factors effecting annual breeding success. This has provided a basis for determining the maximum size of annual harvest in order to maintain an increasing population.

As this population recovered from the low level of 1945, increased numbers of birds began using other migration areas in the northern tier of states (Smith and Davis, 1958). Hunting pressure likewise increased in the vicinity of major concentration areas.

While concern was expressed over the high annual kill in southern Illinois, serious attention was not given to the overall problem until a harvest of about 11,000 geese occurred in Wisconsin in 1957. This resulted in specific attention being given to determination of total kill occurring in the vicinity of all major concentration areas. The subsequent decline in population levels in 1958-59 led to enactment of more restrictive harvest regulations in Wisconsin and Illinois which required more intensive kill surveys to reveal weekly, and in some cases, daily cumulative kill records for the areas concerned. (Nelson, 1961)

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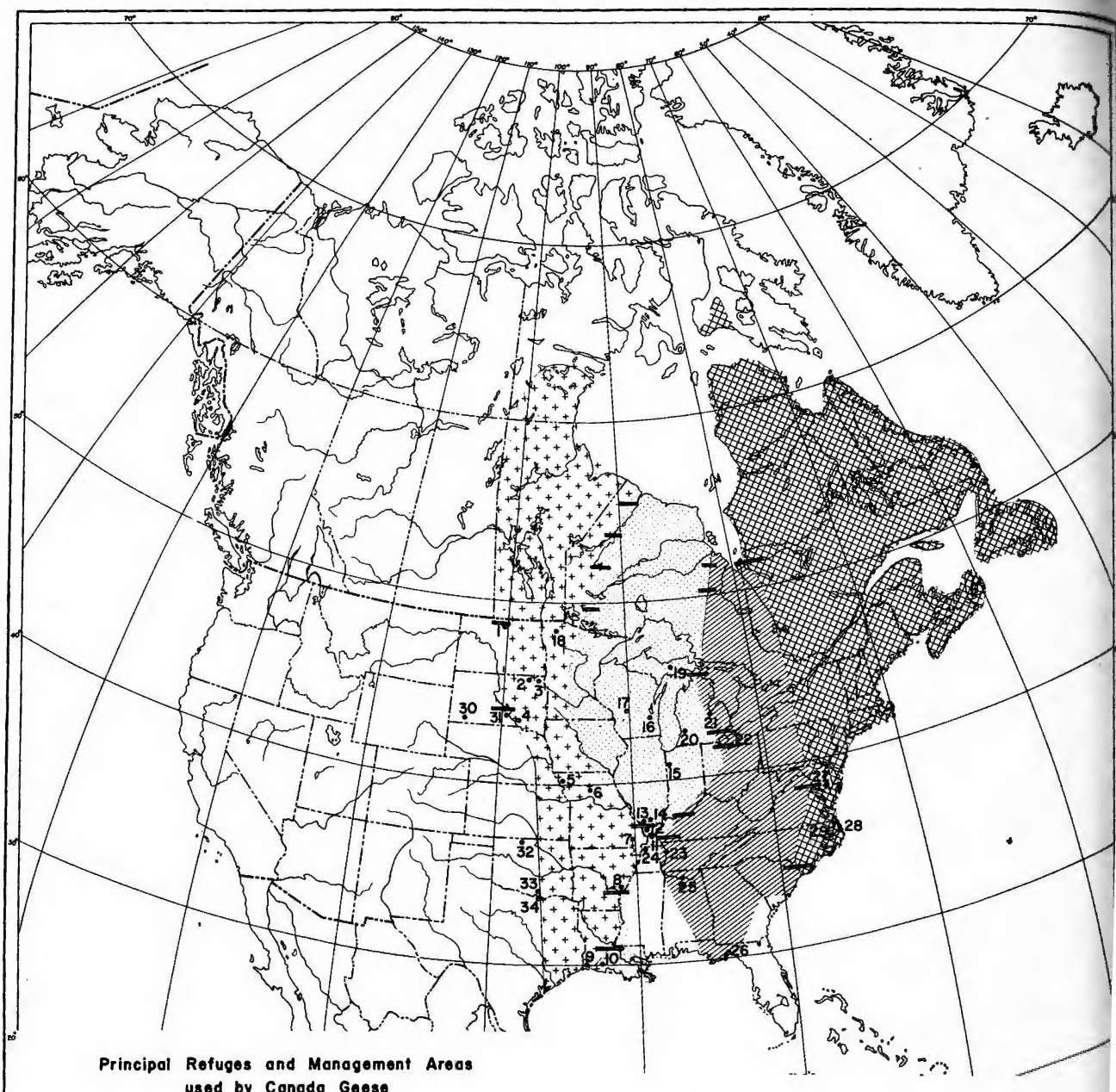


Principal Refuges and Management Areas used by Canada Geese

1	Lower Souris	(F)	18	Mud Lake	(F)
2	Sand Lake	(F)	19	Seney	(F)
3	Waubay	(F)	20	Fennville - Swan Creek	(S)
4	Lake Andes	(F&S)	21	Shiawassee	(F&S)
5	Squaw Creek	(F)	22	Jack Miner	(P)
6	Swan Lake	(F)	23	Tennessee	(F)
7	Mingo	(F)	24	Reelfoot	(F)
8	White River	(F)	25	Wheeler	(F)
9	Sabine	(F)	26	St. Marks	(F)
10	Lacassine	(F)	27	Blackwater	(F)
11	Ballard County	(S)	28	Pea Island	(F)
12	Horseshoe Lake	(S)	29	Mattamuskeet	(F)
13	Union County	(S)	30	Lacreek	(F)
14	Crab Orchard	(F)	31	Chamberlain	(S)
15	Willow Slough	(S)	32	Salt Plains	(F)
16	Horicon	(F&S)	33	Tishamingo	(F)
17	Necedah	(F)	34	Hagerman	(F)

(F) - Federal, (S) - State, (P) - Private

FIGURE 1

RANGES OF CANADA GOOSE POPULATIONS

ALANTIC
MISS. VALLEY
SOUTHEAST
EASTERN PRAIRIE
OVERLAP

UNITED STATES FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

100 0 100 300 500
Statute miles

Table 1 - CANADA GOOSE POPULATIONS AND KILL DATA - 1955-62

Mississippi Valley Flock

	1955	1956	1957	1958	1959	1960	1961	1962
Midwinter Survey Population:								
Illinois*	173,534	190,943	227,825	149,815	204,123	111,209	162,887	158,684
Indiana	4,065	7,612	1,869	12,917	1,173	9,203	3,180	784
Ohio	2,647	1,954	2,089	2,470	748	1,566	1,476	1,568
Michigan	18,275	10,580	8,650	7,947	5,068	8,958	6,601	6,728
Wisconsin	5,564	5,527	2,605	4,176	4,065	5,509	20,248	4,316
Total	204,085	216,616	243,038	177,325	215,177	136,445	194,392	172,080
Kill:**								
Wisconsin	7,500	9,000	11,000	19,400	29,600	14,000	14,100	
Illinois***	24,400	41,000	62,500	45,500	24,700	18,200	23,000	
Indiana	800	1,000	1,000	1,200	600	1,200	1,000	
Michigan****	2,500	2,500	3,000	2,800	3,100	3,600	2,400	
Ohio	---	---	---	---	1,700	1,800	2,300	
Total	35,200	53,500	77.500	68,900	59,700	38,800	42,800	

*Includes all Illinois areas and southeast Missouri. Ballard County, Ky., data included for 1956, 1957, 1958, 1960-62. (Estimate only for 1956-57; 35,000 present in 1958; 8,000 in 1959 but not included in midwinter survey data above; 7,280 in 1960; 2,500 in 1961; and 6,100 in 1962.)

**Includes 20 percent crippling loss. (Actual crippling loss in Illinois may not run this high.) Reflects kill in vicinity of major concentration areas, not state-wide.

***Includes Crab Orchard, Horseshoe Lake, Union County, Ill.; southeastern Missouri, and Ballard County, Ky.

****Upper peninsula and southwestern Michigan.

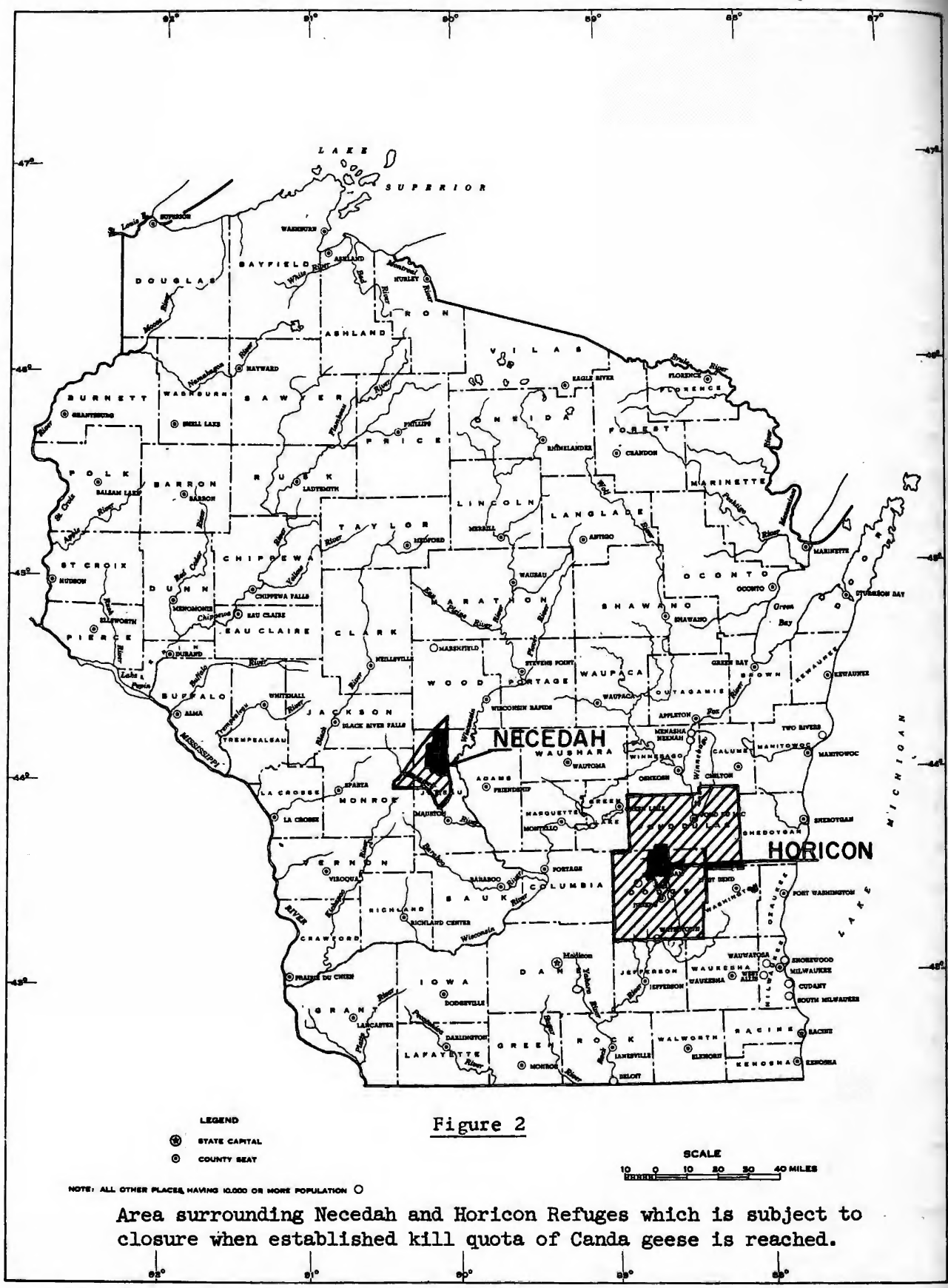
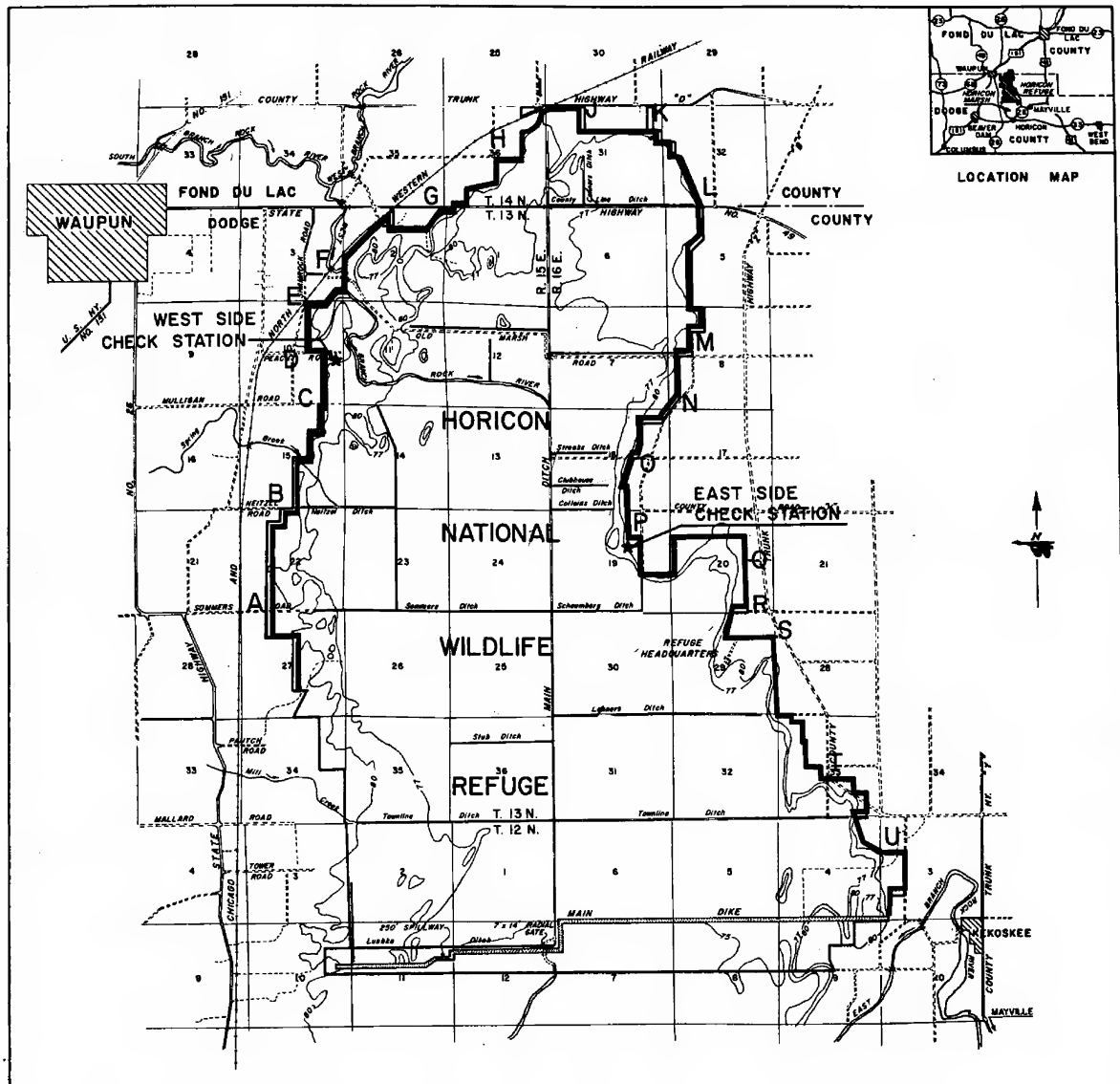


Figure 2

Area surrounding Necedah and Horicon Refuges which is subject to closure when established kill quota of Canda geese is reached.

FIGURE 2a

U. S. FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
HORICON NATIONAL WILDLIFE REFUGE



ACCESS POINT	BLIND NUMBER	ACCESS POINT	BLIND NUMBER
A	1 - 11	K	51 - 55
B	12 - 16	L	56 - 62
C	17 - 22	M	63 - 69
D	23 - 25	N	70 - 72
E	26 - 29	O	73 - 78
F	30 - 33	P	79 - 88
G	34 - 40	Q	92 - 93
H	41 - 44	R	94 - 96
I	45 - 47	S	97 - 99
J	48 - 50	T	101 - 108
		U	109 - 114

LEGEND

(LETTERS) ACCESS POINTS

——— MANAGED WATERFOWL HUNTING AREAS.

WISCONSIN CONSERVATION DEPARTMENT AND U. S. BUREAU OF SPORT FISHERIES AND WILDLIFE (COOPERATING)

The harvest quota system was initiated in the Mississippi Flyway for the Mississippi Valley population of Canada geese in 1960. Because of the population decline as indicated in table 1, the Bureau, with consent of major States concerned, determined that the kill, excluding crippling loss, should not exceed 30,000 in 1960 in order to allow recovery. Since approximately 90 percent of the total kill normally occurred in Illinois and Wisconsin, the States concerned, through the Mississippi Flyway Council, requested that quotas of 7,000 for Wisconsin and 14,000 for Illinois be established and that Bureau regulations provide for closure of goose hunting in given counties in these States when the specified number of geese were taken. Thus it became imperative that accurate kill data be obtained for the major areas concerned. It was also essential that such data be collected on a weekly and finally a daily basis so that the cumulative kill and daily rate were known and the necessary closure action could be started prior to attaining the established maximum quota. The compulsory club license and daily reporting of goose kill in southern Illinois required only slight modification of procedures to meet existing needs. Procedures for obtaining current kill data in the vicinity of the Horicon National Wildlife Refuge in Wisconsin are discussed in further detail.

The intensity of kill surveys in the vicinity of major goose concentration areas will depend upon local needs. The Illinois system and the Horicon plan are designed to give daily cumulative totals if necessary, where harvest quotas are established. In other areas, it may only be necessary to design a sampling system that will give a measurement of total harvest after the end of the hunting season for annual reporting purposes. Depending upon hunting pressure, distribution of hunting activity, size of kill, and promptness with which information is desired, various types of mail questionnaires may also give the information required with considerably less effort and expense.

HORICON AREA

The U.S. Fish and Wildlife Service and the Wisconsin Conservation Department entered into an agreement in the fall of 1953 which permitted the State of Wisconsin to conduct managed public hunting on a strip of land approximately 125 yards wide within a portion of the exterior boundaries of the Horicon National Wildlife Refuge (fig. 2a). This agreement is still in effect. Minor annual revisions have been made in operational procedures. Procedures were developed to close hunting on the area within 24 hours' notice when 15 percent of the average peak population had been harvested.

In 1957, the opening of the goose hunt was delayed 2 weeks after the opening of the waterfowl season, and shooting was stopped at 2 p.m. Both regulations were designed to permit geese to establish definite feeding flight patterns, with the hope that this would increase the number of birds which could be harvested from the managed area.

These measures were effective immediately, and in 1959 an excessive harvest of geese occurred requiring an early closure of the season.

In 1960 the delayed opening was eliminated. It was hoped that this change, together with a bag limit of 1 goose per day, prohibition of shooting from roadsides and railroad rights-of-way in the 2 p.m. zone, requiring all blinds to be at least 75 yards from the refuge boundary, and enlargement of the 2 p.m. zone would tend to spread the kill over a longer period.

Further details on layout of the managed public shooting area and applicable area regulations are shown in figure 2a and appendices D and E.

Table 2 shows the number of hunters and known kill each year on the State Managed Public Hunting Area; the estimated total harvest for the Horicon vicinity, excluding crippling loss; and fall peaks and total days of goose use from 1953 through 1961.

Table 2 - CANADA GOOSE POPULATIONS AND HARVEST

Horicon National Wildlife Refuge

Year	Managed hunting area: Number hunters	Managed hunting area: Kill	Range of estimated total kill from flock	Fall populations: Fall peak	Fall populations: Total days use	Days of hunting
1953	16,738	655	2,031	30,000	1,203,000	55
1954	17,689	1,114	2,313-2,383	47,600	2,060,000	55
1955	16,262	2,324	5,989-6,521	31,000	1,241,000	70 1/(63)
1956	11,760	2,159	4,548-7,390	68,600	1,941,000	70
1957	13,318	3,284	8,057-11,480	37,400	1,354,229	56 2/
1958	11,158	5,248	15,000-16,000	50,300	2,316,195	33 3/
1959	15,299	8,664	23,000-25,000	75,000	3,024,000	49 4/
1960	4,921	3,002	10,550	73,000	5,587,455	9½ 5/
1961	5,118	2,449	11,141	98,000	6,252,665	10½-18 6/

1/ Blinds closed Mondays.
2/ Opening delayed until October 15.
3/ Closed early because of high kill. (Wisconsin Department Order G-905)
4/ Closed early because of high kill. (Wisconsin Department Order G-927)
5/ Closed early because of high kill. (Commission Order G-940)
6/ Closed early because quota was reached.

AREA GROUND SURVEY

Determination of Area of Influence

In connection with the managed public hunting done on the refuge from 1953 through 1960, information was gathered on flight lanes, distance of feeding flights, extent of potential shooting outside the managed area, etc. Information was gathered both by State and Service personnel, from the ground and from the air, and provided a good basis for arriving at some idea of the primary area of influence of the Horicon Refuge goose flock.

1959 Field Surveys

Based on check station information and general knowledge of distribution, it was considered for several years that about 50 percent of the total kill of Horicon birds were killed in the State-managed blinds, and the other 50 percent outward from that area.

In the fall of 1959 it became apparent that perhaps not enough was known about the harvest from the flock and since the annual kill had been steadily increasing, the need for more precise information became more important. Accordingly, a plan was set up to obtain kill information from private holdings and hunting clubs around the refuge and to pinpoint more accurately the area of influence. Forms distributed to nearby landowners, lessees, and private hunting clubs (appendix F) provided space for the landowner or club to record the total geese taken from their lands each day. Because the plan was set up just before the opening of the hunting season, it was not possible to cover as much area as desired, but as many farmers were contacted as possible. Provision was made to pick up the forms once each week so that at the end of the season it would be possible to more accurately estimate the possible total kill from the area. In arriving at total kill, all records from the State Managed Public Hunting Area were included. These check station records show close to 100 percent of the kill from the managed area. To this, the data obtained from nearby landowners were added, and a total kill was calculated. It was found that the minimum harvest from the Horicon flock was about 26,000 geese. It further developed that the State-managed blinds did not account for half of the total kill; but rather that only about one-third of the kill occurred in State blinds, one-third from the immediate periphery, and one-third farther back from the refuge.

Establishment of Harvest Quotas

At the time of the 1960 midwinter inventory, the Mississippi Valley Canada goose population showed a drop nearly 37 percent below the 1959 inventory figure, and drastic steps were suggested to safeguard further serious decimation. Accordingly, harvest quotas were set up.

The 1960 Wisconsin kill quota of 7,000 Canada geese under State and Federal regulations was confined to Dodge and Fond du Lac Counties surrounding Horicon Refuge, and Juneau County in which Necedah Refuge is located. It has since been necessary to revise the closure zone around Necedah to

include portions of Wood, Monroe, and Juneau Counties. Future programs will be based on the areas of influence as shown in figure 2.

With the establishment of a harvest quota, the need for a more precise kill survey became apparent, and plans were made in the spring of 1960 for obtaining this kill information during the fall hunting season.

Establishment of Zones and Sectors

In order that a definite pattern of kill survey coverage could be set up, the area of influence around Horicon Refuge was divided into four major zones (fig. 3). Since previous work had demonstrated that nearly two-thirds of the total kill occurred in the State Managed Public Hunting Area and private lands within about 1 mile of the refuge, it was evident that most emphasis had to be placed on obtaining kill information from private lands within that area. The check stations adequately covered the Managed Hunting Area, so activities were concentrated within 1 mile from the exterior boundary of the refuge. This constituted zone 1 of the survey plan.

Observations in past years, and especially in 1959, indicated that zone 2 should logically be about 2 or 3 miles in width. Thus, so far as possible, taking existing county roads into account, this zone was laid out as shown on the map. Zone 3 was established to average about 5 miles in width, again depending on existing roads. Zone 4, as shown, was laid out as a standby in event it was learned geese were being killed that far from the refuge. No coverage was planned unless needed, and as it developed, no coverage was necessary.

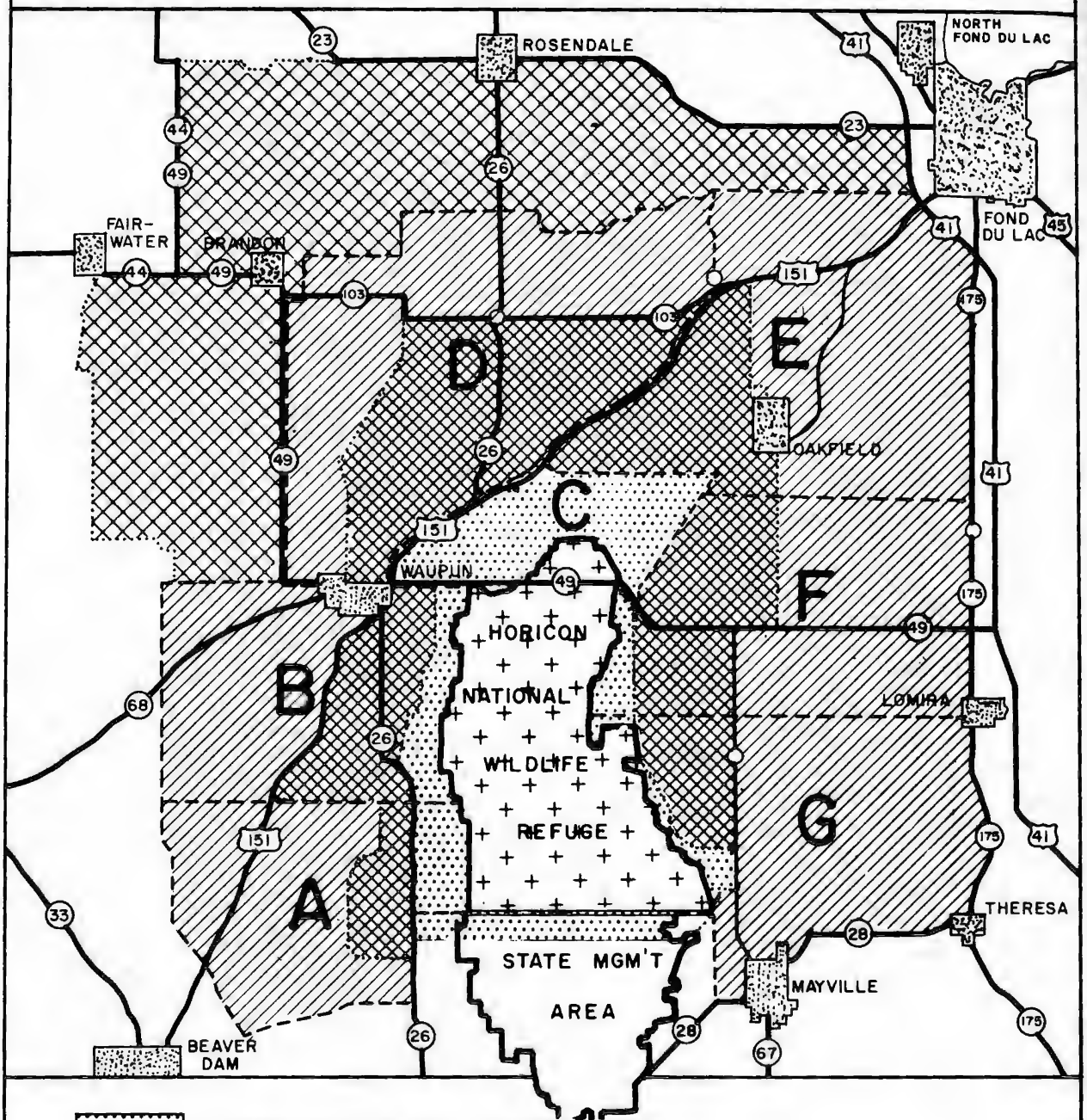
As indicated in figure 3, the area to the south of the Horicon National Wildlife Refuge is managed by the State of Wisconsin as the Horicon Marsh Wildlife Management Area. Because duck hunting was permitted there and because the nature of the terrain and character of the marsh prevented much goose movement in that direction, it was possible to concentrate on the remaining portion of the refuge boundary.

After the zones were laid out around the refuge, they were divided into seven sectors, as shown in figure 3, with one man assigned to each. The size and number of sectors in the future at Horicon, or on any other area using this plan, will depend on availability of manpower and the intensity of the sampling plan.

Overall responsibility for the survey was assigned to one man, in this instance the refuge clerk, who not only handled the important sector C, but also supervised the activities of other sector personnel, coordinated their activities, and maintained a cumulative record of information received. The refuge clerk was selected for this job because he was intimately familiar with the area and with most farmers; he had a keen interest in the project, he would be present on the job throughout the season; and it would relieve the refuge manager for other duties.

Special instructions were prepared for sector personnel at the start of the survey. (See appendix G.)

FIGURE 3 - GOOSE KILL SURVEY AREAS



ZONE 1 - CONTACT EVERY FARM

ZONE 2 - CONTACT EVERY 5th FARM

ZONE 3 CONTACT EVERY 10th FARM

ZONE 4 CONTACT EVERY 20th FARM

------ OUTLINE OF CHECK AREA AND SECTORS TO BE SAMPLED

Sampling Procedures

Farmers, club members, or lessees within the zones were contacted during September to secure their cooperation in maintaining a daily kill record on lands they controlled. Forms (appendix F) were distributed to all cooperators, and arrangements were made for picking up reports at regular intervals.

Sampling intensity was intended to be proportional to the importance of zones to the anticipated kill. Cooperation was therefore solicited within zones as follows:

Zone 1:	Contacted ALL farms.
Zone 2:	Contacted every 5th farm.
Zone 3:	Contacted every 10th farm.
Zone 4:	Planned on contacting every 20th farm if needed; or more intensively if "hot spots" developed.

If a farmer was contacted who did not wish to cooperate, the next farm was taken in order. For example, if farmer No. 10 in zone 3 would not cooperate, he was listed as a "noncooperator" for record purposes, but farmer No. 11 was contacted instead. However, in making the next jump, only nine farms were bypassed, so that farm No. 20 was next in order to keep the pattern of every 10th farm constant. The sample principle applied to zones 2 and 4.

To give some idea of the coverage required, an examination of county plat maps indicated that there were:

Zone 1:	120 farms	120 samples planned
Zone 2:	400 farms	80 samples planned
Zone 3:	900 farms	90 samples planned
	Total sample:	290

This sampling system is technically systematic. However, the pattern of the goose flight varies from day to day with weather conditions, adding an element of randomness. Another element of randomness is the fact that each sector man chose his own route and starting point within his sector. Ideally, starting points should have been established in each sector by random choice and assigned to the sector man. However, for our purpose, this sample will be treated as a random sample.

Collection of Forms from Cooperators

Information obtained during the 1959 hunting season was used as the basis for the pick-up schedule planned in 1960. The plan provided for

picking up the forms from the landowners every three days in zone 1 and every week in zones 2 and 3.

In 1959 the kill averaged about 1,000 birds per day. With additional restrictions in 1960, it was believed that the daily kill rate would drop. Had this been true, the 3-day interval in the highly important zone 1 should have been adequate. However, it was necessary to increase the frequency of pick-ups in 1960 because a high daily kill rate continued. The first pick-up was made after the opening weekend. Kill records from the State Managed Public Hunting Area, together with the reports picked up from private lands, indicated a harvest in excess of 1,000 birds per day. Thus over 40 percent of the quota had been reached after only 3 days of hunting, and it necessitated daily compilation of data to insure that the quota was not seriously exceeded. Accordingly, the frequency of pick-ups was stepped up to a daily basis.

Handling of Data Collected

As soon as the report forms were picked up, they were channeled to the refuge clerk, who was responsible for maintaining a running inventory of the kill. The reports were checked off on the master chart, and kill information was compiled by zones and sectors. Kill data obtained from the various zones were projected as follows:

Zone 1: Actual reports, corrected as described later.

Zone 2: Increased 5 times.

Zone 3: Increased 10 times.

Zone 4: Not used in 1960.

This permitted a daily cumulative record of harvest from the private areas. Also, each day, data from the two State-managed check stations were obtained, and a cumulative total was maintained on the kill from the Managed Public Hunting Area. Thus, except for farms from which kill reports were not obtained and for correction of reports as will be explained later, it was possible to know with a fair degree of accuracy how the harvest was progressing.

When these cumulative data indicated that the quota for the area would soon be reached, action to close the season was initiated and after only $9\frac{1}{2}$ days of the 1960 season, hunting of geese was stopped in the vicinity of the refuge.

Observations to Check Crippling Loss and Validity of Reports

The original 1960 plan called for direct observations of the kill and crippling loss on a farm to be chosen by the observer. The purpose of these observations was to:

1. Obtain data on crippling loss.

2. Observe any unusual goose movements or activity.

3. Provide a check on the accuracy of the kill as reported by the landowner (this would allow a correction of the total estimate for inaccurate reports, if necessary).

Observations were to be conducted on opening weekend and then at 4-day intervals. The kill for the first 3 days exceeded expectations, and it became necessary to conduct observations each day to obtain the necessary data before the quota was reached.

A check of past records from the State Managed Public Hunting Area check stations, together with field observations, indicated that approximately 75 percent of the total daily harvest occurs before 9:30 a.m. On the strength of this information, observations on kill and crippling were discontinued at 9:30 a.m. each day. The observed kill was assumed to be 75 percent of the day's total, and for purposes of comparison with the reported kill it was simply expanded to 100 percent.

The 1960 season observations, corrected and reported, as well as crippling loss, are summarized in table 3.

The "corrected" total from the 35 days of observations shows a kill of 400 geese, while actual reports from the same areas for the same days show only 337 geese killed. Then if all assumptions are correct, the total kill reported for zone 1 in which the observations were all made can be corrected for inaccurate reports by the following procedure:

63 (difference between reported kill and observed calculated harvest on certain farms under observation)

4,020 (total reported kill by farmers in zone 1)

337 (reported kill on farms under observation)

X (correction necessary for underreporting)

63 : 337 as X : 4,020 = 751 (correction for underreporting)

The same method was followed in the 1961 season with only one important change. Observers were instructed to remain on the area they chose to observe each day until by their estimate 90 percent of the daily kill had occurred.

This method has provided a correction in the kill both in 1960 and 1961. In both years the corrected kill from the observation areas exceeded the reported kill. However, the differences are not satistically significant because of high variability of both observed and reported kills. Examination of table 3 shown that the reported kill equals or exceeds the corrected kill in better than half the cases. The greater share of the difference in the totals of reported or corrected kills is due to only a few excessively low reports.

Table 3 - OBSERVATIONS TO DETERMINE ACCURACY OF KILL DATA REPORTED AND CORRECTIONS APPLIED

Area	Date	Reported kill	Observed kill data Actually seen	Corrected*	Crippled
A-5	10-10	9	12	16	1
A-5	10-13	12	23	31	2
B-4	10-10	3	2	2	0
B-11	10-15	0	8	11	3
B-14	10-12	0	36	48	5
B-14	10-15	0	17	23	4
C-1	10-7	0	0	0	0
C-1	10-11	66	38	51	13
C-1	10-13	41	17	23	4
C-11	10-10	0	0	0	0
C-11	10-13	7	5	7	2
C-40	10-7	7	9	12	0
F-1	10-8	37	22	29	8
F-3	10-11	2	4	5	1
F-6	10-11	5	3	4	1
F-6	10-13	1	1	1	0
F-9	10-7	1	1	1	2
F-9	10-14	0	3	4	1
F-11	10-7	0	0	0	0
F-13	10-12	8	16	22	7
F-13	10-13	10	10	13	2
F-14	10-11	3	3	4	1
F-14	10-13	9	7	9	1
F-14	10-14	17	15	20	3
F-14	10-15	14	4	5	0
F-14	10-16	4	5	7	3
F-15	10-9	7	7	9	0
F-15	10-15	0	5	7	1
G-1	10-14	4	7	9	0
G-2	10-10	10	3	4	1
G-4	10-8	13	1	1	1
G-7	10-7	7	4	5	4
G-7	10-8	34	14	19	5
G-25A	10-7	5	3	4	1
G-25A	10-10	1	2	3	2
35 observations		337	307	413	79

*We assume the observer saw, on the average, 75% of the daily total kill. The corrected figure is simply the observations expanded to 100%.

The calculated value for the differences of the paired data is 0.96, which is insignificant. Given the same variance, it would require at least 160 pairs of observations to produce a significant value. Analysis of the data from the 1961 season gives an even more discouraging estimate in spite of the fact that the effort was doubled.

Two conclusions are possible:

1. The importance of the difference in reported kill and corrected kill is overestimated.

2. The method of assessing the difference in reported kill and corrected kill requires some improvement.

We favor the second of these conclusions until there is better evidence to support the first. The alternatives are to improve the method as it stands, or to devise an entirely different approach to the problem.

Improvement of the existing method is possible. The first step would be to select the areas on which observations are to be made through the use of a table of random numbers. (As applied in this study to date, the daily choice of the area within an assigned sector was left up to the observer.) Then, if possible, examine each area chosen to see whether it requires more than one man to cover it adequately, and assign manpower as needed.

A new method would be to eliminate the data received from the least-accurate cooperators and simply assign an average based on observations to these areas. The ultimate in new methods would be a club licensing system and compulsory daily reporting of the kill on each licensed farm or club.

Determination of Crippling Loss

Crippling loss was determined as the result of observations conducted behind various State blinds and private blinds throughout the hunting season. These observations showed:

Table 4 - COMPARATIVE CRIPPLING LOSS

Area	Number of observations	Killed and retrieved	Lost as cripples	
			Number	Percent
State blinds	42	196	57	22.5
Zone 1	44	350	100	22.2

Note: Ten observations were made in zone 2, and 4 in zone 3; but insufficient data were obtained to permit projecting a crippling loss. After such discussion with all persons concerned, it was agreed that a loss of 5 percent could conservatively be assigned to zones 2 and 3 and to the State area south of the refuge.

Crippling loss was calculated as follows:

State-managed area

3,002 geese actually reported bagged

22.5 percent loss (then 3,002 geese represent 77.5 percent of total kill)

77.5% : 3,002 as 100.0 : X = 3,873

3,873 total loss to flock

less 3,002 reported bag

871 lost as cripples

Zone 1 (other than State-managed area)

5,096 geese (corrected kill): 4,020 reported

751 correction

325 from unreporting farms

22.2% crippling loss (then 5,005 birds represent 77.8% of total kill)

77.8% : 5,096 as 100.0 : X = 6,550

6,550 total loss to flock

less 5,096 calculated birds bagged

1,554 lost as cripples

Zones 2 and 3, and State area to south

2,495 geese bagged (1,275 from zone 2, 920 from zone 3, and 300 from State area to south)

5% crippling loss (figure mutually agreed upon as conservative)

95% : 2,495 as 100.0 : X = 2,626

2,626 total loss to flock

less 2,495 estimated actual bag

176 lost as cripples

Compilation of Total Harvest Data

In compiling total harvest data, records from the State-managed public hunting area, from private lands, calculated cripples, and harvest from the State area south of the refuge were included.

Table 5 shows kill records from the check stations on the State-managed public hunting area. Note that the State asked all its hunters to report observed bag behind State blinds. This gives some indication of zone 1 harvest, but includes only a portion of the kill taking place in that zone. Note, too, that cripples reported by hunters in the State blinds are fewer than those actually observed by sector personnel. Table 6 shows determination of kill on adjacent private lands. Table 7 summarizes estimated total harvest of the flock in the Horicon vicinity.

Table 5 - 1960 RECORDED KILL--STATE MANAGED BLINDS

Date	Daily kill	Accum. kill	State-blind cripples Daily	State-blind cripples Accum.total	Kill reported BEHIND State blinds by State blind hunters Daily	Kill reported BEHIND State blinds by State blind hunters Accum.total
Oct. 7	97	97	14	14	54	54
8	358	455	66	80	404	458
9	392	847	74	154	95	553
10	312	1,159	56	210	184	737
11	286	1,445	59	269	195	932
12	278	1,723	51	320	302	1,234
13	332	2,055	68	388	277	1,511
14	386	2,441	47	435	282	1,793
15	342	2,783	70	505	303	2,096
16	219	3,002	56	561	198	2,294

Note: Crippling loss reported by State-blind hunters amounted to 15.7% compared with actually observed loss of 22.5% in the State blinds. This is easily explained, because the State hunters were asked, "How many geese did you KNOCK DOWN that you did not retrieve?" Thus, they were not reporting on "sailers" that eventually dropped. Observers watched numerous geese set their wings and sail off, only to drop some distance from where they were hit. All parties concerned with the Horicon hunt agree that the observed loss is more accurate and should be used.

Kill from the private lands surrounding the refuge was determined as follows:

Table 6 - DETERMINATION OF KILL ON PRIVATE LANDS

Zone 1

Sector	Kill reported from farms and clubs
A	339
B	583
C	1,739
F	682
G	677
	4,020

Reported kill	4,020	
Unreported	325*	
Correction	751	(from observations as previously explained)
Total zone 1 kill	5,096	

Note: No zone 1 in sectors D and E.

Zone 2 (20% sample)

Sector	Reported kill
A	12
B	84
D	9
E	63
F	40
G	47
	255

255 x 5 = 1,275

Zone 3 (10% sample)

Sector	Reported kill
A	20
B	21
D	20
E	30
F	1
G	0
	92

92 x 10 = 920

*Estimated kill on unreported farms (from observations, etc.).

Table 7 - ESTIMATED TOTAL HARVEST

Actual Bag

State-managed blinds	3,002
Zone 1 - reported	4,020
Zone 1 - correction	751
Zone 1 - unreported farms	325
Zone 2 - projected kill	1,275
Zone 2 - projected kill	920
State area south of refuge	300
Actual Bag	10,593

Total Loss to Flock

State-managed area	3,873	(kill and cripples)
Zone 1	6,550	(kill and cripples)
Zone 2	1,275	(kill only)
Zone 3	920	(kill only)
State marsh south of refuge	300	(kill only)
Crippling loss on State area south of refuge, and zones 1 and 3 - estimated at 5%.	176	
Total loss to flock	13,094	

Costs

Approximately 120 man-days were spent on the kill survey in 1960. This includes preliminary contacts, distribution of forms, pick-up of forms, analysis of data, and compilation of the final reports. Classifications ranging from laborer at $1.75 an hour to GS-12 were involved. Probably the average wage of a GS-7 would be a mean figure, so the cost is estimated at $20 a day. Thus, an intensive field survey such as used at Horicon in 1960 will cost about $2,400 in salaries. Transportation has been averaged out at about $2.50 a day, for another $300; while depreciation of vehicles, per diem, and materials cost an additional $300. Thus, the entire survey cost

approximately $3,000, including manpower, or about $600 if time is excluded from the figure.

Summary of 1961 Season

During the 1961 season, the quota around Horicon Refuge was divided, as follows: the quota for the entire area was set at 10,000 geese. Hunting was permitted in all of Dodge and Fond du Lac Counties until such time as the kill reached 8,500 geese. At that time, the 2 p.m. zone was closed and hunting allowed to continue to the outlying areas of those counties until the full quota was reached. Within 10½ days of the season, the 8,500 level had been reached and the 2 p.m. zone was closed. Hunting continued for an additional 8 days in the remainder of the two counties. Total kill was computed to be 11,141 geese.

A total of 5,118 hunters used the State-managed blinds during the fall, harvesting a total of 2,449 geese.

Goose use of the refuge reached an all-time high, with birds peaking at 98,000 and with a total of 6,252,665 days of goose use recorded for the season.

The following table indicates total harvest from the Horicon flock during the 1961 season.

Table 8 - 1961 GOOSE HARVEST--HORICON NATIONAL WILDLIFE REFUGE

	Geese Bagged	
State-managed blinds (MGH)		2,453
Brown Zone:		
Reported	2,029	
Correction	562	
Nonreporting farms	100	2,691
Yellow Zone:		
Reported	1,865	
Correction	852	2,717
Blue Zone (reported)		2,780
Additional outside kill:		
State area	200	
Eldorado area	300	500
	Total Bag	11,141

	Crippling Loss	
MGH	902	
Brown Zone	851	
Yellow Zone	271	
Blue Zone	146	
Outside	26	2,196
	TOTAL LOSS TO FLOCK	13,337

Annual Changes in Distribution of Kill

Early in the history of the managed goose hunt at Horicon Refuge, it was considered that at least half of the total kill came from the MGH blinds.

In 1959 when we started our own kill surveys, information suggested that about one-third of the kill came from the MGH blinds; another one-third from the area immediately behind them; and the remaining one-third from outside.

The kill survey was intensified in 1960, and it was found that only 28 percent of the kill came from the MGH blinds; 48 percent from the brown zone; and 24 percent from the outlying areas. This still showed 76 percent of the kill in the 2 p.m. zone as opposed to 24 percent outside that area.

In 1961 blind spacing was increased further, and all hunting in the 2 p.m. zone had to be done from blinds. It was hoped that this would help move the kill more to the outside areas. Whether this was the reason or not, it was found that this year the kill was almost evenly divided between the 2 p.m. zone (which included the MGH and brown zone areas) and the portions lying outward of the 2 p.m. zone. Kill occurred this fall in areas away from the refuge where no kill had occurred before. Examination of the data indicates the following distribution of kill this fall:

MGH	22% of total kill	2 p.m. zone: 46% of total kill.
Brown zone	24% of total kill	
Yellow zone	24% of total kill	outside 2 p.m. zone: 54% of total.
Blue zone	25% of total kill	
State and other	5% of total kill	

The following table shows how the distribution of kill has changed over the past 3 years.

Table 9 - PERCENT OF TOTAL KILL

Area	1959*	1960	1961
MGH	33.00	28.45	22.02
Brown zone	33.00	47.91	24.15
Yellow zone	33.00	12.08	24.39
Blue zone	(incl. in yellow)	8.72	24.95
State area & other	1.00	2.84	4.49
TOTAL	100.00	100.00	100.00
2 p.m. zone	66.00	76.36	46.17
Outside 2 p.m. zone	34.00	23.64	53.83

*Rough estimate, based on data at hand.

Apparently blind spacing, requiring that all hunting in the 2 p.m. zone be done from blinds, and elimination of right-of-way hunting have tended to spread the harvest over a wider area. With blind spacing as it was this year, it was possible for birds to move out of the refuge between blinds, thus escaping the "lead curtain" which so effectively drove them back into the refuge in the past.

This trend for the kill to move into areas further removed from the refuge has increased the problem of conducting the kill surveys and will undoubtedly result in more intensive coverage in the outlying areas in the future.

However, the 1961 mail surveys showed a comparable correlation with ground survey figures as was apparent in 1960 and indicates that the method in use can be adapted and refined to provide the necessary data.

MAILED QUESTIONNAIRE--HORICON AREA*

Purpose

This work was carried out as an experiment in the development of an economical method of estimating the cumulative goose harvest in the vicinity of the Horicon National Wildlife Refuge in Wisconsin.

Methods

Preparation of Mailing Lists

Previous work with mailed questionnaires indicates that farmers have an interest in wildlife conservation and are able to provide valuable information. In the case of this particular area, the goose harvest is of considerable interest because it also provides direct income to a number of farmers.

The first step was to obtain a complete listing of all farmers in the area involved. This was accomplished through cooperation of the State ASC office which had farmers catalogued by townships. The townships provided a basis for a rough stratification.

The list was arbitrarily divided into three discrete samples. A name was chosen at random and each third name thereafter was used to make the first list. The second list was chosen by starting with the first name remaining and every third one following; and the third consisted of those remaining.

Names were typed on perforated pages of gummed address labels with an original and two carbons. The original labels were separated and pasted on 3- x 5-inch index cards to be used as a master list. The first carbon was used for the mailing label, and the second was held ready to sample from in the event that an extra mailing would be needed to cover the entire season.

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*Conducted by Charles W. Lemke, formerly Division of Research and Planning, Wisconsin Conservation Department; currently Wisconsin State Board of Health, Statistical Services Division.

Questionnaire Design

A copy of the questionnaire used for the first 3 days of the season and an accompanying letter appear in appendices A and B.

Some of the questions may appear redundant in that they ask if hunting occurred, and then how many hunters; if geese were killed; and then how many. There are reasons for this arrangement. Experience with other questionnaires indicates that some people who are not able to answer questions exactly will either pass on without making any answer, or will simply not return the questionnaire. This procedure of asking the simple question that can be answered by "yes" or "no" first provides a "memory jog." It serves to get the potential respondent thinking about it and prepares him for the question on "how many." If he still cannot answer "how many," it will at least be known that hunting occurred on his farm. He will be more apt to return the questionnaire if he can answer at least parts of it with ease and accuracy. This information makes possible a small correction for the number of farmers that were aware of goose hunting and goose kill on their land, but could not provide an estimate of the number of hunters or the kill.

Distribution

Once the season opening date is known and the length of the periods is decided, questionnaires can be prepared for mailing. Three questionnaires were sent. The first covered the period from October 7 through 9; the second, October 10 through 14; and the third covered October 15 and 16. Cooperators were provided a postpaid return envelope with each questionnaire. This is slightly more expensive than using a post card, but it is worth the difference as it gives the questionnaire a little more prestige and also keeps the reply confidential.

Handling of Returns

As questionnaires were received, they were recorded in the master file for each questionnaire period. As soon as it appeared that the return was practically complete, the respondents' cards were removed. A sample of approximately 100 of the remaining nonrespondents was drawn from each period. These farms were located with the aid of plat books and in some cases through the local post office. Lists were prepared giving the township and section of each, and as many as possible were interviewed to provide a correction for nonresponse.

Stratification

The purpose of stratification is to divide a heterogenous population into subpopulations, each of which is less variable than the entire population. For this first effort, our stratification was done as simply as possible--on a township or town-line basis. The kill was estimated separately for each stratum and added to get the total.

Costs and Time

Postage for the total of 2,477 questionnaires and return envelopes sent out was $171.24. Cost of material and preparation of lists amounted to $135.

The greatest expense is in interviewing nonrespondents. This required 20 man-days. Approximately 1 month of time and expense was used in administration and execution of the survey. This latter can be greatly reduced in the future once the survey becomes routine.

The mailing costs can be reduced slightly by (1) better allocation of sampling, resulting from information gained from the first attempt, and (2) use of first-class business-reply envelopes which require payment of postage only for those returned.

Preseason Publicity

News releases explaining the survey and its purpose were prepared and distributed directly from the Wisconsin Conservation Department office at Madison (See appendix C). The best approach was through direct contacts with local wardens, local game managers, county agricultural extension agents, and representatives of the ASC. They were all helpful in getting information into their columns in the local papers and in relaying information in their contacts with farmers in the area. They were all furnished an informational release which they could use verbatim, or in part, and were also given several appropriate photographs which they could offer to the papers.

Results

Cumulative Harvest Estimate

Table 8 summarizes the harvest estimate data. Estimates for each period must be added to obtain the season total for private land. The total kill from public blinds, for the unchecked State area, and corrections for low reporting and unreported farms must be added to the corrected season total to get the final grand total kill.

Table 10 - CUMULATIVE HARVEST ESTIMATE, MAILED SURVEY

Period	A. Uncorrected Estimate	B. Corrected for Nonresponse	C. % Difference $\frac{A - B}{A}$ 100
Oct. 7-9	2,898	1,872	35.4
Oct. 10-14	5,568	3,288	40.9
Oct. 15-16	2,543	1,616	36.8
Private land total:	11,009	6,776	38.5
Public blinds, State area, unreported farms, etc.		4,340	
Grand Total:		11,116	

The grand total retrieved kill estimated from the mailed survey compares very favorably with that obtained from the intensive ground survey (10,555).

Variability of these data is naturally high and is further complicated by less than ideal stratification. Table 10 gives the cumulative kill on private land only, and by periods, for both the ground survey and the mailed survey.

Table 11 - COMPARISON OF HARVEST ESTIMATES BY PERIODS

(Private Land Only)

Period	Horicon Plan	.05 Limits	Mailed Survey	.05 Limits
Oct. 7-9	2,510	± 13%	1,872	± 43%
Oct. 10-14	2,700	± 12%	3,288	± 36%
Oct. 15-16	1,005	± 12%	1,616	± 16%
Total Sample	6,215	± 6%	6,776	± 13%
Total Known	4,340		4,340	
Grand Total	10,555		11,116	

Table 11 presents the estimated harvest for each of the three periods of the mailed questionnaire, and data from corresponding periods for Horicon ground survey. The 0.05 limits for the estimates from the samplings are also given. The variance of estimates of the kill on private land is relatively high. However, this variability is applicable to only about 60 percent of the total kill each year. In terms of the total kill, then, it is not so excessive. The sampling intensity can be reduced somewhat and still provide reasonable precision in terms of the total kill when a portion of the total is known from registration, rather than estimated from a sample.

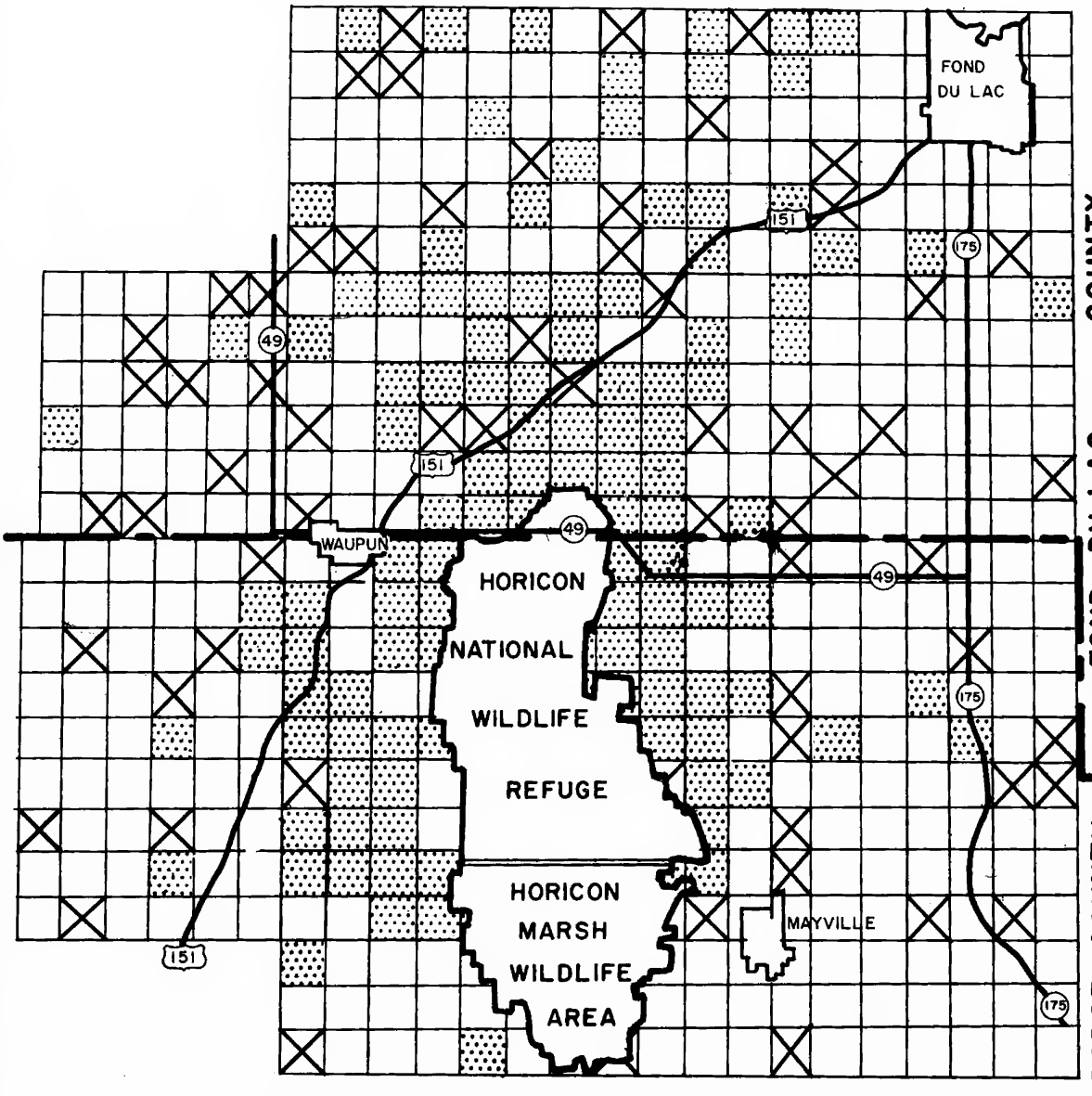
This variability may possibly be reduced in the future by improvement in the stratification and in allocation of the sample proportionally to variance within each stratum.

Figure 4 represents the distribution of the goose harvest around Horicon Marsh and the distribution of goose hunting effort.

The Return

The return from the 1960 questionnaire (table 12) indicates that a preliminary estimate, not corrected for nonresponse, could be made in about 5 days following the end of the period covered by the questionnaire. For all practical purposes the return was complete about 12 days from the end of the period, and a final corrected estimate could be made as soon as the required number of nonrespondents had been interviewed. The correction for nonresponse reduced the estimates by an average of 38.5 percent. This correction may differ with the goose population or with hunting conditions. The nonresponse check is a necessity at present. After a few years of experience it may be possible to estimate the progress of the harvest relative to previous years by comparing the uncorrected estimates, but for the present more information is required.

FIGURE 4 - DISTRIBUTION OF HUNTING EFFORT AND GOOSE KILL AROUND HORICON MARSH DURING THE 1960 SEASON *



Occurrence of Successful Goose Hunting during Sample Period.

Occurrence of Unsuccessful Goose Hunting during Sample Period.

* Based on Mailed Questionaires.

Table 12 - PROGRESS OF RETURN

Mailing Date	Report Period	No. Deliv.	Date	Accum. Ret.	Cum.%
Oct. 7	7-8-9	627	Oct. 14	151	24
			18	188	30
			21	201	32
Oct. 13	10-11-12-13-14	691	Oct. 19	215	31
			21	243	35
			26	275	40
Oct. 15	15-16	783	Oct. 20	203	26
			24	268	34
			27	308	39

The rate of return varied between strata. The best and fastest return came from farms nearest the marsh where the kill is highest. There is a natural tendency for people with the most to report to be the most prompt in reporting. A total of 781 questionnaires were sent to farmers in townships bordering the marsh and 40 percent were returned. 1,320 questionnaires were sent to farmers in the townships of the outer ring that do not border on the marsh. They averaged only a 36.4 percent return. These ratios yield a chi-squared value of 3.462, which lies between probabilities of 0.06 and 0.07.

A group of 140 cooperators on the first questionnaire were resampled on the final questionnaire. The return from these experienced cooperators amounted to 48 percent in the same time required to get a 37 percent return from those contacted the first time. The return of both experienced and inexperienced might have been greater except for the fact that it was known that the season was to be closed before the questionnaires were received.

Duplicate Reports Between Surveys

The mailed survey and the ground survey both rely on the cooperation of farmers. The close agreement of results might be criticized by arguing that both rely on farmers. Some farmers cooperated in both surveys, thus they should agree. It is true that some farmers were reporting to both surveys, but it is doubtful whether they influenced the estimates too heavily. A check of respondents to the mailed survey against those cooperating on the ground survey shows approximately 30 farmers reporting on both surveys. The smallest number returned on any mailing was 201 questionnaires. All of the duplicate reports from the 100-percent check zone were compared. Reports on the mailed survey averaged three more geese each than did the same individual's report on the ground survey. Although duplication did exist, it probably did not force the close agreement between the two surveys.

Crippling Loss

The total crippling loss was not measured by this questionnaire. Cooperators were asked whether any dead or crippled geese had been seen on the farm, and if so, how many. This would result in a low figure as it excludes

any "sailers" that reach the marsh before collapsing. If respondents understood the question and answered it accurately, it should be a good estimate of the number of birds that did not reach the marsh. This figure is estimated to be 450. The ground survey showed an estimated 110 cripples in the outer zones and 1,445 for the zone on the perimeter of the marsh. It appears impossible to evaluate or estimate crippling on private land exactly because there is no way of telling how many cripples are picked up, given to an unsuccessful hunter, and then reported as a dead bird.

Application to Future Programs

The Canada goose is still considered a trophy bird by most hunters in Wisconsin, and there is considerable interest even on the part of the nonhunting public. Where geese are hunted, there seems to be enough interest in them so that the landowner can give a fair estimate of the number killed on his land. In areas where land is leased or a fee is charged, it is to his advantage to know as nearly as possible how many geese are killed on his land. This system of mailed questionnaires to landowners around goose harvest areas should provide a relatively simple and cheap means of estimating harvest.

Advantages

Once a mailing list is prepared, randomization of samples is much simpler and surer to be free of judgment samples than other methods.

The mailed survey system is very flexible. Sampling effort can be varied to meet changing conditions brought about by changing regulations or goose populations.

It can provide good information on the distribution of the harvest over the area involved and also throughout the season.

It can be used in combination with a ground survey to cover outlying areas more intensively than would be possible otherwise.

Disadvantages

The principal disadvantage of this system lies in the time lapse from the end of the period until the return is complete enough to provide an estimate. However, in an area where the kill builds up a little slower or the quota is larger, it might be of considerable value in administering the quota system. Under the conditions encountered in 1960, its main value would lie in the postseason kill estimate. Further work may point the way to a more complete return in less time.

No estimate of crippling loss can be obtained from this method. However, use of the mailed survey would free personnel from the "pick-up" and distribution of forms that requires a great deal of time.

Although variance may be reduced in the future, it will probably always be greater than the variance of a ground survey.

Future Improvement Possibilities

Probably the greatest imporvement in the accuracy of the survey would result from improved stratification and sample allocation. One simple possibility lies in subdividing the perimeter of the marsh according to leased hunting rights and land open to day shooting programs or to free public hunting.

Improvement may also result from a well-planned public relations program. It should be slanted locally to the farmers, explaining the quota system and the reason for requesting their help. A more general state-wide program should be slanted to the hunters that use the concentration areas.

Summary of Results of 1961 Season Mailed Questionnaire

Sampling and Return, 1961 Questionnaire

The questionnaire itself was unchanged from 1960, except that a question on the number of blinds was added.

Three changes were made in the sampling method. First, the mailing list was divided into two sections, one for the 2 p.m. closing zone, and the other for the area outside the 2 p.m. closing zone. Second, each of these strata was sampled at a different rate. All farmers in the 2 p.m. zone received a questionnaire in each sampling period, while those outside were sampled at the same rate (33 percent each period) as in 1960. Third, the sampling periods were shortened to 2 days each. (In 1960 the shortest was 3 days, and the longest was 5 days.)

The stratification and shorter sampling periods were improvements, but the attempt to sample all farms in the 2 p.m. zone was a disadvantage. The receipt of frequent questionnaires seems to have stimulated the response at first, but the final result was a loss of interest on the part of the cooperators and the return dropped. The short season also had an adverse effect on the return. The announcement of the season closing date was followed by a drop in the return.

Table 13 - QUESTIONNAIRE RETURN RATES BY ZONES AND BY PERIODS, 1961

Period	Percent return 2 p.m. zone	Percent return outside
Oct. 7-8	43	44
9-10	41	40
11-12	31	34
13-14	25	28
15-16	22	30
17-18	15	29
19	0	25
20	0	26
21-22	0	21

Nonresponse, 1961

Nonresponse interviews were carried out only in the 2 p.m. zone at the close of the 1961 season. Time was not available to carry out as many interviews as we should like. Information that was gathered indicated that nonrespondents differed less from respondents than was the case in 1960. Inasmuch as this was a small sample, in 1961 the two years were pooled to provide an estimated 30 percent reduction of the 1961 reported kill for nonresponse.

Cumulative Kill Estimate, 1961

The table following summarizes the harvest estimates for each period of the season as derived from the questionnaire returns and corrected for nonresponse.

Table 14 - HARVEST BY PERIODS AND BY ZONES, 1961

Period	2 p.m. zone	Outside zone	Period total
Oct. 7-8	452	993	1,445
9-10	381	662	1,043
11-12	456	592	1,048
13-14	375	735	1,110
15-16	290	384	674
17-18	187*	455	642
19	closed	210	210
20	-	122	122
21-22	-	300	300
Total	2,141	4,453	6,594

*2 p.m. zone was closed on October 17, 1961.

The grand total for the kill of 6,594 on private land, uncorrected for underreporting, etc., compares very favorably with the ground survey estimate of 6,674. Estimates for the harvest in each of the 2-day periods were available within 3 days of the last day of the period.

POSSIBLE ADAPTATION OF HORICON PLAN TO OTHER AREAS

Determination of Area of Influence

One of the first steps to be taken before any plan of hunter survey is set up should be a determination of area of influence as a guide for developing the extent of coverage needed. This can best be done by observations on flight patterns, movements of birds to and from the refuge, the effect of physical features on bird movements, the effect of weather and food conditions, population pressures on the refuge, gunning pressure around the area, and initial determination of areas where greatest kill occurs.

Basically, it is desirable to know where, when, and how birds move away from and back to the refuge, and how far they range and disperse after they do leave. Once this information is available, the groundwork for a hunter-survey plan will have been completed.

Establishment of Zones and Sampling System

Zones

Every concentration area will have definite patterns of goose movement, hunter pressure, and harvest; and these will normally fall into definite zones around the refuge.

Hunters tend to concentrate along the refuge boundary, and much of the harvest will occur here on the perimeter of the refuge. This area of concentrated kill would usually constitute zone 1 of the survey plan. Under conditions existing at Horicon, we found that a good workable size for this zone is approximately 1 mile in width.

Zone 2 will vary, depending on local conditions, and can be best determined on the ground for each individual refuge area. It will be subject to revision from year to year as more refined information permits a clearer cut delineation of the outer boundary. Our zone 2 at Horicon averages 2 to 3 miles in width.

The same holds true for zone 3 limits. However, to start with, it is recommended that zone 3 be confined to approximately 5 miles in width until additional information permits closer delineation.

Zone 4: This zone may seldom, if ever, be needed. If activated, it is recommended that this zone be about 5 miles in width.

Size of local goose populations, daily flight patterns, and size and areas of hunter concentration will dictate the intensity of survey. To set up an initial hunter survey, it is recommended that at least three zones be established, subject to refinement as conditions and experience dictate.

Sectors

The number of sectors required will depend upon the availability of manpower, the coverage required to obtain the necessary information, and the frequency of sampling needed.

Each area will have to determine the size and number of sectors which are either needed or possible to man; and these requirements will have to be based on needs of the individual area.

Frequency of Pick-ups and Sampling Intensity

Both pick-ups and intensity of sampling will depend on the use to be made of kill data. When total season kill alone is the goal, perhaps a smaller sample of farms or landowners will furnish sufficient information. Possibly even in zone 1 a sample of every 5th or 10th farmer will permit gathering enough data, with correspondingly lighter sampling in zones 2 and 3. Here, the management requirements will have to be one of the deciding factors, along with availability of manpower and the inherent variability of the data.

The frequency of picking up reports from cooperating farmers will also vary according to the needs of the particular refuge. However, a minimum of

weekly pick-ups is recommended to insure close contact with the cooperator and impress the cooperators with the fact that the refuge is interested in these data. Too long an interval between pick-ups may well lull the cooperator into thinking the reports are really not important, and this will tend to lessen reliability. Weekly pick-ups, on the other hand, remind the cooperator that the refuge is interested in the kill and tend to maintain his interest in the effort of preparing reports.

When a quota system is involved, the frequency of both sampling and pick-up of reports will necessarily have to be increased, as will the number of sectors. No sector should be so large that the man assigned to cover it will not be able to perform all the tasks assigned; and as frequency of sampling or pick-up of reports is increased, the size of the area which can be handled by one man will correspondingly decrease.

The following sample system has proven workable at Horicon and is suggested as a standard which may be adjusted according to the needs and experience of the individual area:

Survey Coverage Within the Zones at Horicon

Zone 1: Contact ALL farmers, if possible. Pick up forms daily in short season or toward closing; every third day otherwise.

Zone 2: Contact every 5th farm. Pick up at least once a week, oftener as season closing approaches.

Zone 3: Contact every 10th farm. Pick up at least once a week, oftener as closing approaches.

Zone 4: (if set up) Contact every 20th farm, or more intensely if local "hot spots" develop. Pick up weekly if necessary.

Further study needs to be given to the use of questionnaires in determining goose kill in the vicinity of concentration areas, particularly when it is necessary to obtain a daily cumulative kill figure.

SUMMARY

A brief history is presented on the growth of the Mississippi Valley population of Canada geese, previous harvest problems encountered, development of the goose flock associated with the Horicon and Necedah National Wildlife Refuges, establishment of the public hunting program administered by the Wisconsin Conservation Department on the Horicon Refuge, and recent changes in hunting activities and Canada goose kill in Wisconsin and southern Illinois.

Increasing Canada goose population and excessive kills in the vicinity of major concentration areas during recent years has focused attention on the need for controlling annual harvest of specific goose flocks. The initiation of the kill quota system in 1959 as applied to the States of Wisconsin and Illinois, where the greatest harvest of Canada geese from the Mississippi

Valley population occurs, required that intensive kill surveys be carried out on managed hunting areas and in the vicinity of concentration areas to give as accurate daily kill data as possible.

The information presented outlines the cooperative kill surveys carried out by the Bureau and the Wisconsin Conservation Department in the vicinity of the Horicon National Wildlife Refuge during 1959-60 to obtain statistically valid kill data through an area ground sample system and a mailed questionnaire.

Suggestions are offered on possible adaptation of the Horicon kill survey plan for use on other areas where it is necessary to determine cumulative goose kill as the hunting season progresses.

Suggestions are offered regarding determination of need for intensive area kill surveys, procedures for determining area of influence for local goose flocks, and modification of sampling methods to meet requirements for kill data in the vicinity of other concentration areas.

During both 1960 and 1961, there was a close correlation between data obtained through the Horicon ground kill survey and the mail questionnaire, as shown below:

TOTAL SAMPLED

(Does not include State-managed blinds)

	1960	1961
Ground Survey	6,215	6,674
Mail Survey	6,776	6,594

Acknowledgements

We appreciate the assistance of Lester Dundas, Refuge Manager, and his staff at the Horicon National Wildlife Refuge; James Bell, Game Manager, and his staff at the Horicon Marsh Wildlife Area; Richard Hunt, Research Biologist, Wisconsin Conservation Department; and local State conservation officers and U.S. game management agents in carrying out operational phases of field surveys. Many other Bureau and State employees offered advice and assistance in planning the surveys and analyzing results. Dr. Harold Hanson of the Illinois Natural History Survey provided information on population dynamics of the Mississippi Valley population. Additional guidance was received from Arthur Hawkins, Mississippi Flyway Representative, and information in his files was utilized. Dr. Aelred Geis offered suggestions for treatment of data. We also wish to acknowledge editorial assistance received from Miss Ruth Hine of the Wisconsin Conservation Department.

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Wisconsin Conservation Department
Madison 1, Wisconsin

October 7, 1960

Dear Sir:

Goose hunting has become very popular in the past few years. With this popularity, many problems have developed. One of the hardest jobs is to regulate the hunting properly. We would like to have hunters take as many geese as possible, but not more than can be replaced by next year's breeding season. If we shoot too many geese, we will pay the price in fewer geese and less hunting opportunity next year.

Good hunting rules depend on knowing how the goose harvest is progressing during the season. People like yourself who live in the major goose hunting areas can help us get information on the goose kill, on the distribution of hunters, and on land open to goose hunting.

We would like to have you fill out the enclosed questionnaire about these subjects and return it immediately in the envelope furnished. No stamp is needed. Please make your answers as accurate as possible.

No individual replies to this questionnaire will be made public. We will only release averages and estimates of totals.

Your help in this matter will be very much appreciated.

Very truly yours,
GAME MANAGEMENT DIVISION

J. R. Smith
J. R. Smith
Superintendent

Attach: Questionnaire
Return Envelope
Waterfowl Regulations

Wisconsin Conservation Department
Madison 1, Wisconsin

October 7, 1960

Dear Sir:

This questionnaire is sent out to gather information that will help us manage our goose flock, and goose hunting, to the best interests of all concerned. Your immediate reply will be greatly appreciated whether or not any goose hunting was done on your property.

Very truly yours,
GAME MANAGEMENT DIVISION

J. R. Smith
J. R. Smith
Superintendent

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1. Did anyone hunt geese on your land during the three-day period, Oct. 7, 8 and 9?
   Yes_____ No_____ Don't know_____ No hunting allowed_____

2. Please estimate the number of people who hunted geese on your land on each of the following days: (This includes family, friends, employees and others, even though they hunted only part of a day).
   Friday, Oct. 7_____ Saturday, Oct. 8_____ Sunday, Oct. 9_____

3. Were any geese killed on your land during the three-day period, Oct. 7, 8 and 9?
   Yes_____ No_____ Don't know_____

4. Please give, as accurately as possible, the number of geese killed on your land during the three-day period, Oct. 7, 8 and 9.
   Total number of geese killed_____

5. Have you or any of your family or employees seen any crippled or dead geese left by hunters on your farm during the three-day period, Oct. 7, 8 and 9?
   Yes_____ No_____ Number seen, if any_____

6. Do you allow goose hunting on your land - without permission? Yes_____ No_____
   - with permission only? Yes_____ No_____
   - for a daily fee, or blind fee? Yes_____ No_____
   - by lease, for the whole season? Yes_____ No_____

7. Your comments _____

Your name_____ Post Office_____

Route No._____ Box No._____

County_____ Township_____

Wisconsin Conservation Department
Madison 1, Wisconsin

HORICON MARSH GOOSE KILL SURVEY

Horicon Marsh has become the most popular and important goose hunting area in Wisconsin. A number of problems have developed with the growth of the goose population and the interest in goose hunting. One of the most difficult problems is to regulate hunting properly. Hunters should be allowed to take as many geese as possible, but not more than can be replaced by the next breeding season. Heavy concentrations of hunters that lead to a breakdown of sport and sportsmanship must be discouraged. A favorable distribution of the goose harvest among hunters is desirable.

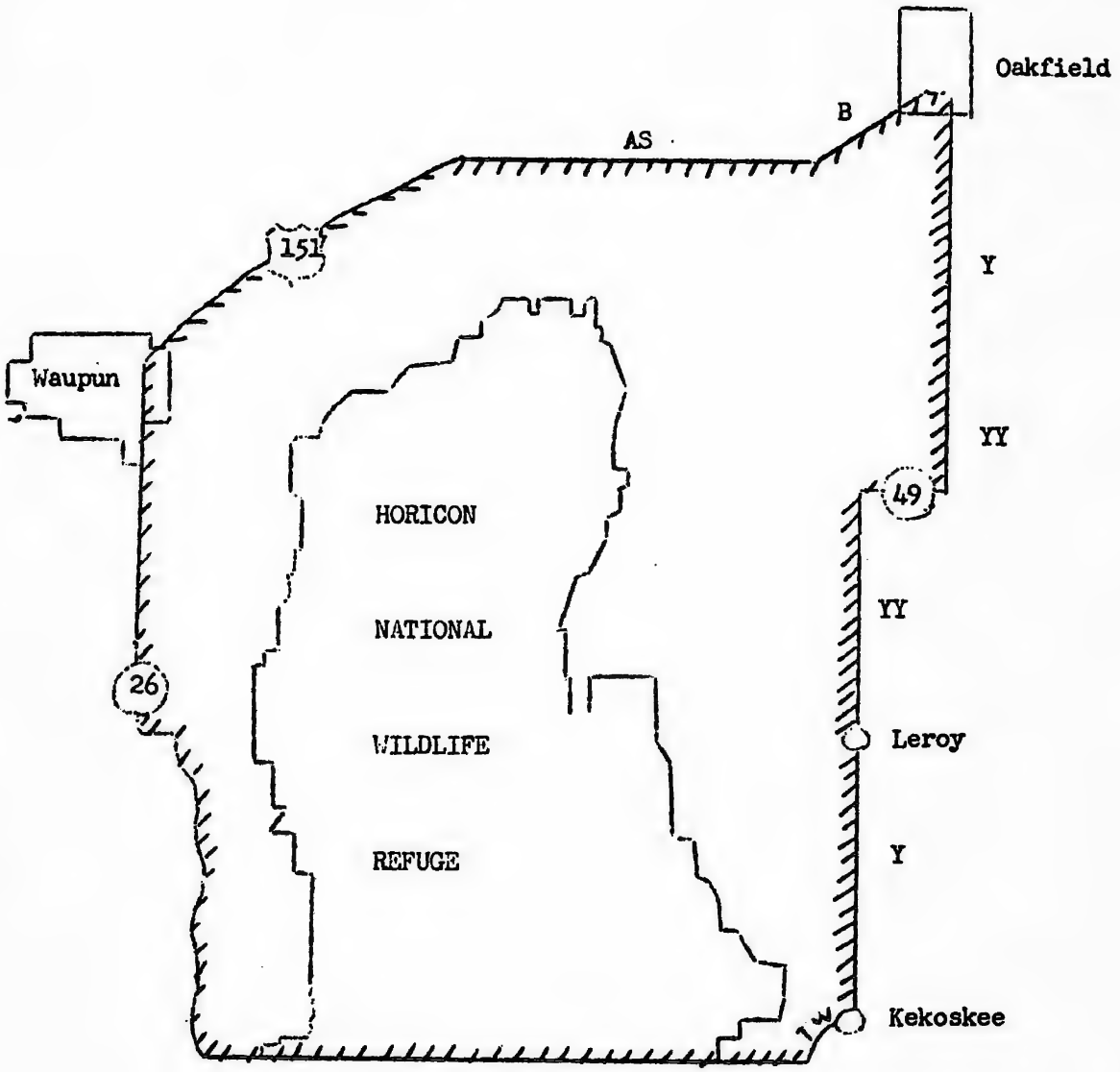
The first of these objectives, taking as many geese as possible but not more than can be replaced by the next breeding season, is the most difficult and the most important as far as the future of goose management is concerned. The first step in reaching this objective is to develop a means of estimating the kill at intervals during the season. This year the Wisconsin Conservation Department and the U.S. Fish and Wildlife Service are cooperating on development of surveys that are intended to provide harvest estimates from the Horicon Marsh goose flock.

Brief questionnaires will be sent to farmers in parts of Dodge and Fond du Lac Counties near Horicon Marsh at intervals during the 1960 goose season. Information will be sought on land open to hunting, on hunting pressure, on whether any goose hunting was done on the farm during the preceding period and on the number of geese killed there. Farmers receiving a questionnaire will be asked to supply answers as accurately as possible and to return it immediately in an envelope which will be provided. The questionnaire should be returned even though no goose hunting occurred during the period covered.

Some people may feel that the purpose of this type of survey is mainly to obtain an early closing of the season. If conditions call for it this may be true. The reverse is also true. If the harvest should be proceeding slowly, the survey might result in a longer open season and increased hunting opportunity. The quota system is expected to become an established practice in the future and we need this type of information to protect our hunting interests as well as to properly manage the goose flock.

The cooperation of people that control the land on which geese are being shot is requested because it would be practically impossible to question the number of hunters necessary to provide an accurate estimate. Another method of estimating the harvest, involving personal contact with a sample of farmers, is also being attempted. The results of the two independent surveys are expected to supplement one another.

9-27-60 ah



BOUNDARY OF 2:00 P.M. CLOSING ZONE FOR WATERFOWL IN 1960

1. Within this zone it shall be unlawful to hunt waterfowl from any public roads or railroads including the respective right-of-ways along or within this zone.

2. It shall be unlawful to place waterfowl blinds or to hunt waterfowl outside the boundary of the Horicon National Wildlife Refuge in Dodge & Fond du Lac counties within a distance of 75 yards of such boundary. Retrieving downed birds will be permitted in this area.

Wisconsin Conservation Department
Madison 1, Wisconsin

1960 MANAGED GOOSE HUNT

REGULATIONS AND PROCEDURE PERTAINING TO HUNTING WATERFOWL ON THE HORICON NATIONAL WILDLIFE REFUGE

SEASON: Goose hunting begins on October 7 and will continue until a total of 7,000 Canada geese has been harvested in Dodge, Fond du Lac and Juneau Counties.
Daily bag limit is one goose of any species. Daily shooting hours are one-half hour before sunrise to 2 p.m.

HUNTING: Permits to hunt may be obtained as a result of a mail reservations system. Blinds for which reservations have been cancelled will be issued on a first come-first served basis to hunters forming a waiting line at either one of two (2) check stations located on the refuge. Also, blinds will be refilled from the waiting line.

APPLICATIONS: Only one application by mail is allowed. Anyone found submitting more than one (1) application will have all applications rejected. Applications cannot be changed once they are submitted. Official applications must be used and may be obtained from county clerk offices and Wisconsin Conservation Department field stations.

Only applications postmarked through September 4 will be accepted. Applications postmarked after this date will be rejected. DO NOT SEND MONEY WHEN APPLYING FOR A RESERVATION. Do not write anything on the application other than the information requested and do not enclose any correspondence with the application. An applicant is not guaranteed a reservation. Reservations will be assigned by a random selection from all valid applications.

RESERVATIONS: Reservations will be mailed before October 1. Only successful applicants will be notified. Reservations are not transferable, nor can the dates be changed. Reservations will be issued for the month of October. In the event the quota of Canada geese has not been reached by October 31, permits for November will be issued to hunters in the waiting line.

Do Not return reservations to the Wisconsin Conservation Department if they cannot be used. Blinds cannot be reserved by phone or in person.

(over)

A person receiving a reservation must present it at the designated check station, along with his hunting license and migratory bird hunting stamp, and will be entitled to bring two (2) guests with him who must be present when he registers for his blind. Guests need not have reservations. A reservation for any one day will be valid only up to one-half hour before the daily shooting time; however, hunters should arrive two hours before shooting time to allow for the issuance of permits.

Only one reservation by mail per season may be obtained. Hunters are not limited in the number of trips as guests of a person holding a reservation; however, hunters in the waiting line shall be allowed only three (3) trips and may be permitted to hunt thereafter only if no other hunters are waiting in line.

BLINDS: Blinds will be assigned in numerical sequence at the time reservations are drawn. The service fee of $3.00 per blind per trip shall be paid AT THE CHECK STATION.

Complete regulations and map of the Horicon National Wildlife Refuge, showing managed hunting unit regulations will be furnished with each reservation.

NOTE: Hunters are cautioned that the season length may be changed during the season by emergency order if the harvest of Canada geese becomes excessive.

8/18/60
mw

United States Fish and Wildlife Service
1006 West Lake Street
Minneapolis 8, Minnesota

Hunter Bag Check Report

and Owner:_____ No.:_____

Date *	No. of Hunters *	Total Canada Geese Killed	Other Geese Killed

* We would sincerely appreciate your cooperation in completing the above form to indicate the total number of hunters present and total geese killed for each day of hunting.

The following instructions were given sector personnel at the start of the survey:

1960 Instructions for Sector Personnel

1. Begin contacting farmers in sector in early summer and not later than August. A definite selling job should be tried on any farmer who does not wish to cooperate, to try to convince him of the need of our obtaining accurate kill information to properly manage the goose flock and perpetuate hunting. A large part of the success of this survey will depend on the salesmanship and ability of each sector man to sell the program to the farmers in his sector.

2. Take forms out to the farmers making up samples one to two weeks before the season opens, and re-establish relations with the cooperator.

3. Furnish a list of names of all farmers who will be cooperating prior to the opening of the season, showing zone number, location, etc.

4. Arrange for the farmers to keep the forms somewhere so they can be picked up even if the farmer is away when the farm is visited. This will cut down on the number of repeat visits required.

5. Pick up the forms once a week regularly, preferably on Monday. Leave a new form in place of the old.

6. Turn the forms in promptly to the Refuge Clerk so he can record data.

A check-off chart will be prepared before the seasons open, with one form as a master control in the refuge office, and one for use of the sector man. This chart will provide for checking off reports when collected, and will enable the Clerk and the sector man to keep a running inventory of reports collected and still to be collected. Thus, in event any sector man is unable for any reason to cover his sector in a given week, it will be possible for someone else to make the route and pick up the reports not in.

7. Starting on opening day, and every 4th day thereafter, make early morning observations somewhere in sector assigned. Observations are to include:

a. Number of geese observed killed.
b. Number of geese crippled (birds knocked down and not retrieved, or birds showing any evidence of being hit). This is essential to arrive at an average crippling loss figure.
c. Show date, location, and time of observation.
d. Show number of blinds under observation, with notes on the success from each blind.
e. Indicate number of hunters under observation.
f. Note anything observed regarding goose movements in the area.
g. Observations to be made from opening hour until 9:30 a.m. on each morning that surveys are made.

Appendix H

HORICON MANAGED GOOSE HUNT

Regulations* for the 1960 Hunt

U. S. Bureau of Sport Fisheries and Wildlife

and

Wisconsin Conservation Department

(a) The open season for hunting geese on the Horicon National Wildlife Refuge shall begin on October 7 at 12 noon. Daily shooting hours shall be ½-hour before sunrise to 2:00 p.m. The season length or bag limit or both may be curtailed by emergency order if the kill becomes excessive.

(b) Hunting on the managed hunting unit on the Horicon National Wildlife Refuge is permitted under permit only as authorized by the Bureau of Sport Fisheries and Wildlife.

(c) Hunting on such refuge shall be done only under the following conditions:

The Horicon National Wildlife Refuge is divided into 2 units as follows:

1. MANAGED HUNTING UNIT. The managed hunting unit varies in width, but is not more than 440 yards wide as marked by single strand of wire, or as posted by the Wisconsin Conservation Department. A single row of blinds spaced approximately 200 yards apart shall be provided by the Wisconsin Conservation Department to accommodate not more than three hunters per blind.

2. REFUGE UNIT. The refuge unit shall include all land in the Horicon National Wildlife Refuge not designated above as the managed hunting unit. Within this unit, it shall be unlawful to hunt in any manner at any time.

3. RESERVATIONS. Reservations for hunting in the managed hunting unit may be obtained under the following conditions:

(a) Reservation requests by mail only on official application forms will be accepted at the Wisconsin Conservation Department, Madison. Such requests must be postmarked no later than September 4. Applications which are postmarked after the above date will be rejected.

(b) Only one official application form per person may be submitted and anyone found submitting more than one (1) application for a reservation will have all applications rejected.

(c) Selections of mailed application forms will be made by random drawing from all eligible applications submitted.

(d) Reservations are not transferable and the person whose name appears on the reservation must present the reservation in person at the designated check station, (along with his hunting license and migratory bird hunting stamp). A reservation will entitle the applicant to bring not more than two (2) guests with him. (Guests must be present when he registers for his blind.)

(e) Only one reservation by mail per applicant may be obtained. Hunters are not limited in the number of permits as guests of a reservation holder, however, hunters in the waiting line shall be allowed only three (3) permits and may be permitted to hunt thereafter only if no other hunters are waiting in line.

(f) All reservations for any one day will be valid only up to one-half (½) hour before the daily shooting time.

4. MANAGED HUNTING UNIT PROHIBITIONS. Within the managed hunting unit it shall be unlawful to:

(a) Enter without first having obtained the necessary permit (arm band) in person at one of the checking stations. Such permit shall be valid for only one day.

(b) Leave the immediate vicinity of the managed hunting unit without first surrendering the permit in person at the checking station where it was obtained. The immediate vicinity of the managed hunting unit is defined as the special area in which the 2 p.m. closing hour is in effect as shown in the current Waterfowl Regulations Pamphlet.

5. Blinds will be assigned in numerical sequence at the time reservations are drawn. Reservation confirmations will contain assigned blind number. Vacant blinds will be issued on a first come-first served basis.

6. Hunters without reservations must form a line to apply for blinds, and trailers and busses will not be permitted in the line. Automobiles must be occupied at all times by persons without reservations desiring to register for blinds.

7. Arm bands to hunt on the unit are non-transferable and no permittee shall occupy or shoot from any other than his assigned blind.

8. A service fee of three dollars per blind per trip shall be paid by each party. A party consists of from 1 to 3 hunters.

9. Hunters must keep their guns unloaded and enclosed in a carrying case at all times except while occupying assigned blinds.

10. Dogs are not allowed on the managed hunting unit.

11. No person shall leave any refuse in any blind or in the managed hunting unit, and immediately upon terminating his hunting trip shall deposit all refuse in containers provided at managed hunting unit access points.

12. When finished hunting, each hunter must surrender, in person, his numbered arm band at the checking station through which he entered, and there submit for examination such game as he may have bagged, not later than 3:30 p.m.

13. Hunters must park at designated access points and driving to and from blinds is prohibited.

*Supplemental to Migratory Waterfowl Regulations - 1960 Pub. no. 712 - 60 Wisconsin Conservation Commission.